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EXHAUST EMISSIONS FROM THE LAFORCE FALCON

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Environmental Protection Agency
Ann Arbor, Michigan

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Division of Emission Control Technology
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16. Abstracts

The exhaust emission characteristics of a 1967 Ford Falcon, extensively modified with the LaForce system, was evaluated using the 1975 test procedure to determine if the latest configuration could approach emission levels required for 1975 and 1976. The LaForce system consisted of numerous modifications. The production carburetor had been replaced by an extensively modified Holley two barrel. To further reduce hydrocarbon emissions the accelerator pump cam was modified to reduce the pump shot to the minimum the engine required. The carburetor's float bowl had overflow ports on each side to drain fuel back to the tank on cornering. The exhaust manifold had been insulated and modifications had been made to provide for increased spark advance during start up. Test results are summarized and tabulated. The modifications made to the vehicle enabled a previously uncontrolled car to meet emission levels required by the 1972 Federal exhaust emission standards. The emission levels were far above the 1975 and 1976 requirements and the system was to complicated to be considered as a retrofit package for uncontrolled vehicles.

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Carbon monoxide
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Background

The exhaust emission characteristics of a 1967 Ford Falcon extensively modified by Mr. Robert LaForce of Beaver, Pennsylvania, were previously evaluated using the 7-mode test cycle at EPA's old Willow Run Laboratory. Several modifications were made to the system after that test. The LaForce vehicle was scheduled for additional evaluation using the 1975 test procedure to determine if the latest configuration could approach emission levels required for 1975 and 1976.

Vehicle Tested

The LaForce system consisted of numerous modifications to a 1967 Ford Falcon. The basic power train was a 200 cubic inch six coupled to an automatic transmission.

The production carburetor had been replaced by an extensively modified Holley two barrel. The carburetor utilized two different air inlets. The primary inlet passed air through the venturi's where it was mixed with fuel. A second inlet on the back of the carburetor by-passed the venturi's and did not mix any fuel with the air. The second inlet was used during deceleration to eliminate the high unburned hydrocarbon levels which occur during high manifold vacuum conditions on uncontrolled vehicles. To further reduce hydrocarbon emissions the accelerator pump cam was modified to reduce the pump shot to the minimum the engine required. The carburetor's power valve was also modified. Air velocity in the primary inlet was measured and the power valve would not fully open until a predetermined velocity was reached.

The carburetor's float bowl had overflow ports on each side to drain fuel back to the tank on cornering. The bowl was also equipped with a drain that allowed fuel to be pumped from the bowl back to the tank after the engine was shut-off to reduce evaporative emissions.

The exhaust manifold had been insulated. Air was pumped into an air space between the manifold and the insulation where it was preheated before being injected into the exhaust ports to induce further oxidation of pollutants which were not completely burned in the cylinder. At the exit of the exhaust manifold was a venturi. Exhaust gases flowing through the venturi caused more air from the preheater to be drawn into the exhaust.

Modifications had also been made to provide for increased spark advance during start up in an effort to reduce the high hydrocarbon levels that occur when a vehicle is cold started.

The camshaft had been retarded 6° to increase the exhaust gas dilution of the next charge.

Tests Conducted

The 1972 Federal Test Procedure was used to compare the emissions from the LaForce car to the 1972, 1973, and 1974 Federal Standards. This test involves starting the vehicle after it has been parked in a 68-86°F ambient for at least 12 hours and operating it on a chassis dynamometer for a simulated 7.5 mile urban drive. Vehicle exhaust is diluted to a constant volume and a portion of the dilute exhaust is collected continuously throughout the 23 mile test in a Tedlar (inert plastic) sample bag. The concentrations of pollutants in the sample bag are then measured. A flame ionization detector (FID) is used to determine unburned hydrocarbon (HC) concentration. Non-dispersive infrared (NDIR) analyzers are used for carbon monoxide (CO) and carbon dioxide (CO_2). A chemiluminescent (CL) analyzer is used to determine nitric oxide (NO) concentration. Nitrogen dioxide (NO_2) concentration was not measured as the NO_2 converter was not operational during the test. Had the NO_2 converter been operational the NOx values would have been slightly higher. Emission results are reported as grams per mile.

The 1975 Federal Test Procedure was used to show how the LaForce car compares to the 1975 and 1976 Federal Standards. The 1975 procedure is similar to the 1972 procedure except that a portion of the dilute exhaust is pumped into three different sample bags. The first bag is filled during the first 3.6 miles of the 7.5 mile cycle, the second bag during the last 3.9 miles and the third bag during the first 3.6 miles after a 10 minute shut down. The pollutant concentrations are read with the same instrumentation used for the 1972 procedure. Mass emissions in grams per mile of vehicle operation are calculated after weighting factors are applied to the cold and hot start bags.

Test Results

Test results are summarized in Table I. The first part of Table I compares the test run using the 1972 procedure to the 1972, 1973, and 1974 Federal Emission Standards. The LaForce vehicle produced lower emission levels than required by the 1972 Federal Standards.

The second part of Table I compares the data using the 1975 Federal Test Procedure to the 1975 and 1976 Federal Standards. Emission levels from the LaForce car were more than five times higher than required.

Summary and Conclusions

The modifications made to the vehicle enabled a previously uncontrolled car to meet emission levels required by the 1972 Federal exhaust emission standards. The modifications made were much more complex and extensive than required to obtain the emission levels produced. Many features of the system were apparently ineffective. The emission levels were far above the 1975 and 1976 requirements and the system was too complicated to be considered as a retrofit package for uncontrolled vehicles.

Table I

EMISSION TEST RESULTS
(All Data in Grams Per Mile)

1972 Federal Test Procedure

Pollutant	LaForce Falcon	1972 Federal Standards	1973-74 Fed. Standards
HC	2.28	3.4	3.4
CO	38.5	39.0	39.0
NOx	2.71*	-----	3.0

1975 Federal Test Procedure

Pollutant	LaForce Falcon	1975 Federal Standards	1976 Federal Standards
HC	1.73	.41	.41
CO	22.25	3.40	3.40
NOx	2.96*	3.0	.40

*NO only, NO_2 not measured.